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ABSTRACT

Two different groups of subjects--incarcerated adult offenders and freshman nursing students--participated in an academic experiment which employed an individually prescribed learning system. The system featured programmed instructional materials and contingency management procedures to obtain stable cumulative records of learning performance. Contingency contracts and backup reinforcers were used to achieve optimum motivation, as indexed by test scores and ratios of empirically derived estimates to actual times for task completion. Intercorrelations between learning rate, various measures of educational achievement, and I.Q. were not significant. It was suggested that a behavioral analysis of other functions should be explored. (Author)

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THE EFFECT OF CONTINGENCY MANAGEMENT PROCEDURES ON THE RATE OF LEARNING[1]

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Previous studies (Clements & McKee, 1968; Jenkins et al., 1969; Enslen, 1969) have demonstrated the effectiveness of contingency management (CM) procedures on basic education performance. In these studies, CM (defined as the systematic arrangement of reinforcing consequences of behavior) took the form of a contingency contract which specified a given amount of programmed instructional (PI) material to be mastered by *S*. Criterion measures of performance obtained were those of (1) time required to learn the material and (2) test score accuracy. Reinforcers employed included money and items selected from a "Reinforcing Event Menu" (Homme & Tosti, 1965).

The recent development of a highly individualized and structured learning system[2] has permitted the study of individual learning rates across diverse and complex academic subject matter. Moreover, the learning rate obtained by an individual under CM conditions appears to show considerable stability, regardless of the subject matter being learned. Since characteristic learning rates can be demonstrated for each learner, it is possible to compare these rates with variables that are generally held to correlate highly with them. Thus, this study sought to determine the relationship between learning rate, I.Q., reading ability, and academic grade level.

METHOD

Subjects

Two entirely different groups of *S*s were used in this study. One was a group of 40 prison inmates at Draper Correctional Center, Elmore, Alabama, and the other consisted of 27 freshman nursing students at Tuskegee Institute, Alabama. Grade level achievement, as measured by a standardized achievement test, ranged, for the prisoners, from 3.8 to

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[2]An Individually Prescribed Instructional System. Elmore, Ala.: Rehabilitation Research Foundation, 1971.

11.5 grades, with a mean of 7.8. The range for the nursing students was 8.8 to 12.0, with a mean of 10.5 grades. The nursing students scored below the admission cutoff score on entrance tests and would not have been allowed to enter the nursing school were it not for a new academic upgrading program.

Materials

An Individually Prescribed Instructional (IPI) System provided the stimulus materials and the process for obtaining learning rates of *Ss*. The first step of the system is that of administering to the student a standardized achievement test, the Tests of Adult Basic Education (TABE).

After the TABE has been scored, the instructor, or learning manager, *diagnoses* the student's deficiencies by compiling an analysis of his learning deficiencies. This is accomplished by recording each error made on the achievement test under the proper category on a special Modular Analysis of Learning Difficulties (MALD) form. After this information is recorded on the MALD, the learning manager *prescribes* for the student's deficiencies, based on the diagnosis. The MALD indicates each deficiency that should be treated and in what order. It also indicates the page number in a "Prescribing Catalog" on which one can find a list of the materials to treat a particular deficiency. By using the MALD and the Prescribing Catalog, one next prepares a prescription for a student's deficiencies on another special form--the Study Schedule.

Assignments are broken down into weekly segments, and as many segments or units are listed on the prescription as are required to bring the student up to a 12th-grade average in all areas tested by the TABE. Each segment of work consists of what a student can be expected to accomplish in a given period of time. This unit of work is put into the form of a "contingency contract" which the student is expected to complete before the end of the week. If he finishes sooner than the estimated number of hours, he can accept another contract. The contingency contract requires a progress test for each module and a score of 85% or better on all module tests. Scores below 85 necessitate the student's being assigned an alternate module and its corresponding test.

A reinforcer different from the prisoner students' was provided for the nursing students. The former earned points which were exchanged for money at the end of the week for each module completed; the nursing students were permitted to leave the learning area after contract completion. (A previous study by Clements & McKee, 1968, showed

that option to leave the learning area, contingent upon completion of a contract, was an effective reinforcer.)

Students were given a wide selection of programmed materials in both language skills and mathematics. At the completion of a prescription, the student was administered a different form of the TABE achievement test to determine his grade placement gain. If significant deficiencies still occurred, another prescription was compiled, based on the achievement posttest, which sought to bring the student to the desired grade level.

Procedure

In the prescribing catalog of the IPI system, modules of subject matter were assigned empirically derived time estimates for completion, thus permitting comparisons across different types of materials of different lengths. As *S*s went through the modules, actual completion times were recorded. Actual time for each *S* was then plotted against estimated time as a cumulative record of learning rate.

Learning rate was next analyzed statistically as a function of the following measures: initial reading level, initial grade level, final grade level, grade-level change, and I.Q. For the Tuskegee sample, the following measures were also included: initial arithmetic and language levels and average module test score. Specifically, for each *S* the actual time in minutes required to complete modules at the 1,500-minute point (of estimated time) was derived as a score. These scores were correlated by the Phi Coefficient with scores from the various measures.

RESULTS

A. Prison Sample Correlational Results

Table 1 below presents correlational results on various measures of the prison sample.

TABLE 1

Intercorrelations of Various Achievement Measures for Prison Sample (N = 40)

Measure	I.Q.	2	3	4	5
1. Learning rate (estimated minus actual time)	-.10	-.25	-.15	-.20	.00
2. Initial reading grade level	.85		.95	1.00	.20
3. Initial grade level	.85			.95	.15
4. Final grade level achieved	.85				.15
5. Grade-level change	.05				

Note.–P-values for Ø coefficients of .26, .31, and .41 were .10, .05, and .01, respectively.

The prediction of learning rate is contained in the top row of Table 1. There is a clear tendency for the predictors to correlate to a slightly negative degree with the criterion of rate. It should also be noted that none of the first-row correlations attains the usually acceptable levels of statistical significance.

The correlations among the basic predictors of initial reading and grade level and final grade level approach unity, as would be expected.

The fact that grade-level change fails to correlate even moderately with the other measures is noteworthy. Extent of change appears to be independent of initial as well as terminal level. Of consequence also is the finding that nearly one-third of the *S*s gained one grade or more, while another one-third gained between one-half and one grade. Only three *S*s showed losses, and these were minute.

B. Nursing Student Results

Table 2 below describes the results of the nursing student study, which should be viewed as a replication of the prison inmate experiment. As can be seen, learning rate correlates slightly negatively with initial reading and grade levels, final grade level, and grade-level change. These data are consistent with the correlational outcomes of the prison group. The correlations among grade level measures and I.Q., however, are appreciably reduced in the nursing sample as compared with the prison group. It will be recalled that there was only a total three grade spread in the nursing sample as contrasted with eight grades in the prison sample. Such a restricted range typically generates a marked reduction in correlation as was found in this instance for the nurses.

TABLE 2

Intercorrelations of Various Achievement Measures for Nursing Sample (N = 27)

Measure	I.Q.	2	3	4	5
!. Learning rate (estimated minus actual time)	.06	-.04	-.33	-.25	-.33
2. Initial reading grade level	.23		.23	.24	-.14
3. Initial grade level	.33			.22	-.42
4. Final grade level achieved	.20				.44
5. Grade level change	-.08				

Note.–P-values for Ø coefficients of .37, .43, and .55 were .10, .05, and .01, respectively.

C. Representative Samples of Cumulative Records of Learning Rates

The figure below depicts three representative samples of high, medium, and low prison learners, as shown by cumulative records for three prison inmates. Both samples of prison and nursing student subjects were fairly evenly distributed among the three groups, though the nursing students showed generally higher learning rates. Interesting, too, was the finding that stable learning rates were exhibited by all learners, with the exception of three *S*s, who showed an occasional acceleration or deceleration in their cumulative records.

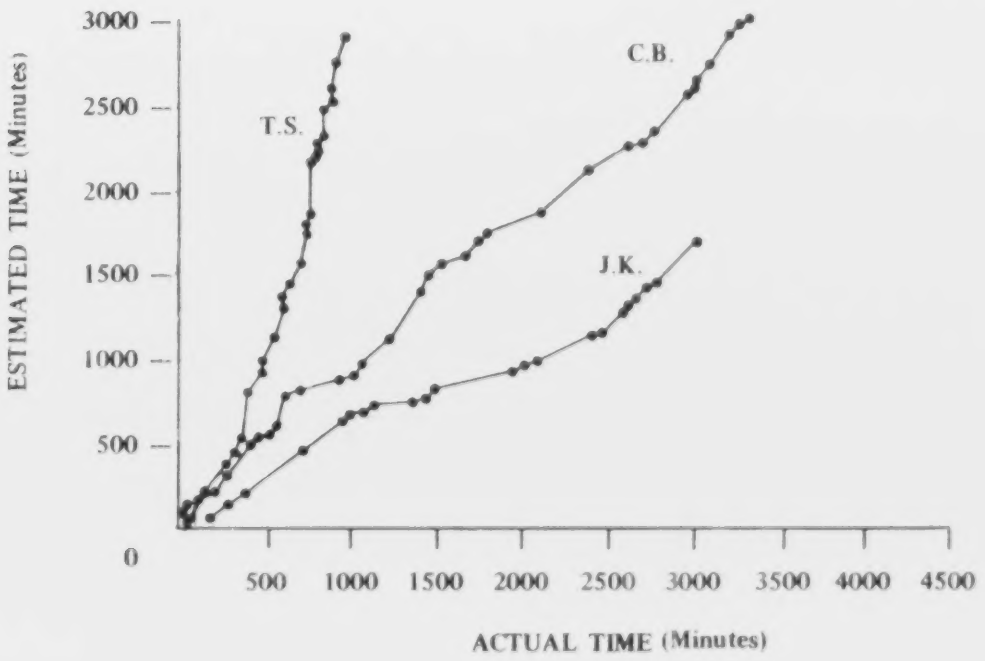

Fig. 1. Cumulative record of estimated and actual times by modules (representative records of three prison inmates).

DISCUSSION

Perhaps the most significant outcome of this study was that of obtaining stable rates of learning in academic subject matter and over a relatively long period of time. The IPI system employed made this possible. The cornerstone of the system is that of providing a pinpoint diagnosis of learning deficiencies and a refined prescription which places the learner in programmed instructional material corresponding closely with his entry skills. The materials themselves possessed other important features to the learning process–self-pacing, active student response, and frequent feedback–which could ensure

certain and steady achievement. Motivation, provided by contingency management procedures, was maintained at a consistent, if not optimum, level.

All of the above arrangements and conditions permitted the experimenter to obtain cumulative learning rates that could be reliably and validly correlated with certain measures that traditionally were thought to be functionally related. For example, I.Q., reading skill, and academic achievement are measures many educators maintain, in "commonsensical" fashion, that have a significant influence upon learning rate. And it is interesting to note that two quite different samples--prisoners and college students--yielded similar results. The data appear to contradict the traditional cause-effect assertion, namely, that low I.Q. is a *cause* of slow learning. Both I.Q. and learning rate can likely be explained as functions of poor educational history. The prison sample more clearly suggests this conclusion, but the performance of both groups shows no significant correlation with the various measures taken. The fact that they did not correlate with learning rate in this study merely suggests one has to look for other explanations of why some people learn faster than others.

What accounts for these individual differences will not be clear without further analysis and research, but other variables do suggest themselves, such as a reinforcement history for a slower pace, more interest in one subject area than in another, or perhaps so-called "style" of learning. Further analysis of the data from this study may reveal these and other clues. An experimental program is now under way at Draper Correctional Center in which different contingency management schedules and procedures are being manipulated in relation to test performance, learning rate, and several other variables. Findings from these studies may very well point to more powerful influences on learning behavior.

SUMMARY

Two different groups of subjects–incarcerated adult offenders and freshman nursing students–participated in an academic experiment which employed an individually prescribed learning system. The system featured programmed instructional materials and contingency management procedures to obtain stable cumulative records of learning performance. Contingency contracts and backup reinforcers were used to achieve optimum motivation, as indexed by test scores and ratios of empirically derived estimates to actual times for task completion. Intercorrelations between learning rate, various measures of educational achievement, and I.Q. were not significant. It was suggested that a behavioral analysis of other functions should be explored.

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